

## CLAIMS

We claim:

1. A method of prevention sulfidation of metals comprising the steps of:  
adding to a fluid including a sulfiding compound an effective amount of a preventative composition, where the composition reduces or prevents sulfidation by deactivating metal sites involved in the formation of atomic sulfur and/or sulfides at or on a surface of the metal.
2. A method of stopping sulfidation of metals comprising the steps of:  
adding to a fluid including a sulfiding compound an effective amount of a preventative composition, where the composition stops or arrests further sulfidation of the metal by deactivating metal sites involved in the formation of atomic sulfur and/or sulfides at or on a surface of the metal.
3. A metal surface treated with a composition comprising an effective amount of a preventative composition in the presence of a sulfiding agent, where the composition and sulfiding agent react with metal surface to form a coating which reduces or prevents sulfidation by deactivating metal sites involved in the formation of atomic sulfur or sulfides at or on a surface of the metal.
4. An apparatus comprising:  
a reservoir containing a sulfidation preventative composition and  
an introduction system in fluid communication with the reservoir and an interior of a container having metal surfaces in contact with a fluid including a sulfiding compound, where the system introduces an effective amount of the composition into the container to reduce or prevent sulfidation of a surface of the metal.

1 5. The method, surface or apparatus of claims 1-4, wherein the composition comprises  
2 a compound having a higher affinity for the metal surface than the sulfiding compound.

1 6. The method, surface or apparatus of claims 1-4, wherein the composition comprises  
2 an effective amount of a phosphorus in the form of a phosphorus-containing compound to  
3 reduce sulfidation of the metal.

1 7. The method, surface or apparatus of claims 1-4, wherein the effective amount of the  
2 phosphorus is between about 0.001 ppm and about 20 ppm in the fluid.

1 8. The method, surface or apparatus of claim 7, wherein the effective amount of the  
2 phosphorus is between about 0.01 ppm and about 10 ppm in the fluid.

1 9. The method, surface or apparatus of claim 8, wherein the effective amount of the  
2 phosphorus is between about 0.1 ppm and about 5 ppm in the fluid.

1 10. The method, surface or apparatus of claim 8, wherein the effective amount of the  
2 phosphorus is between about 0.1 ppm to about 2 ppm.

1 11. The method, surface or apparatus of claim 8, wherein the effective amount of the  
2 phosphorus is between about 0.1 ppm and about 1 ppm

1 12. The method, surface or apparatus of claim 8, wherein the effective amount of the  
2 phosphorus is between about 0.2 ppm and about 0.8 ppm.

1 13. The method, surface or apparatus of claim 8, wherein the phosphorus-containing  
2 compound comprises phosphorus, phosphines of formulas  $\text{PH}_3$ ,  $\text{PRH}_2$ ,  $\text{PR}_2\text{H}$ , and  $\text{R}_3\text{P}$  where  
3 each R is the same or different and is a C1 to C20 carbon-containing group including alkyl,

4 aryl, alkaryl or aralkyl; , phosphites including ammonium phosphites; alkali metal phosphites;  
5 alkaline metal phosphites; phosphites having organic counter ions; phosphates including  
6 ammonium phosphates; alkali metal phosphates; alkaline metal phosphates; phosphates  
7 having organic counter ions; pyrophosphates including ammonium pyrophosphates; alkali  
8 metal pyrophosphates; alkaline metal pyrophosphates; pyrophosphates having organic  
9 counter ions; polyphosphates including ammonium polyphosphates; alkali metal  
10 polyphosphates; alkaline metal polyphosphates; polyphosphates having organic counter ions;  
11 thiophosphates; thiophosphites; or other phosphorus-containing compounds capable of  
12 inhibiting sulfuric corrosion of metal surfaces, or mixtures or combinations thereof.

1 14. A method of pre-treating metal surfaces comprising the steps of:

2 contacting a metal surface with an effective amount of a pre-treating composition  
3 sufficient to deposit onto the metal surface a protective coating, where the coating prevents  
4 or reduces sulfidation of the metal by deactivating metal sites involved in the formation of  
5 atomic sulfur and/or sulfides at or on the surface.

1 15. The method claim 14, wherein the pre-treating composition comprises an organo-  
2 phosphorus compound and the method further comprising the step of:

3 oxidizing the organo-phosphorus compound to a phosphorus oxide compound.

1 16. The method claim 14, wherein the composition comprises a compound having a  
2 higher affinity for the metal surface than the sulfiding compound.

1 17. The method claims 14, wherein the composition comprises an effective amount of  
2 phosphorus in the form of a phosphorus-containing compound.

1 18. The method claims 14, wherein the effective amount of the phosphorus is between  
2 about 0.1 ppm and about 5 ppm in the fluid.

1 19. The method claims 14, wherein the effective amount of the phosphorus is between  
2 about 0.2 ppm and about 0.8 ppm.

1 20. The method claims 14, wherein the phosphorus-containing compound comprises  
2 phosphorus, phosphines of formulas  $\text{PH}_3$ ,  $\text{PRH}_2$ ,  $\text{PR}_2\text{H}$ , and  $\text{R}_3\text{P}$  where each R is the same  
3 or different and is a C1 to C20 carbon-containing group including alkyl, aryl, alkaryl or  
4 aralkyl; , phosphites including ammonium phosphites; alkali metal phosphites; alkaline metal  
5 phosphites; phosphites having organic counter ions; phosphates including ammonium  
6 phosphates; alkali metal phosphates; alkaline metal phosphates; phosphates having organic  
7 counter ions; pyrophosphates including ammonium pyrophosphates; alkali metal  
8 pyrophosphates; alkaline metal pyrophosphates; pyrophosphates having organic counter ions;  
9 polyphosphates including ammonium polyphosphates; alkali metal polyphosphates; alkaline  
10 metal polyphosphates; polyphosphates having organic counter ions; thiophosphates;  
11 thiophosphites; or other phosphorus-containing compounds capable of inhibiting sulfuric  
12 corrosion of metal surfaces, or mixtures or combinations thereof.